

Utilizing NASA Resources to Provide Multi-Frequency Observations of Clouds and Precipitation for ACE and CaPPM Ground Validation

Completed Technology Project (2015 - 2016)



Project Introduction

The goals of this project are to conduct a science-engineering study to optimize use of the D3R and ACHIEVE radar systems (hardware and software) to obtain robust co-located Ku/Ka/W-band measurements of clouds and precipitation, and to conduct a detailed engineering design study to assess the feasibility of adding Ku-band, dual-polarized measurement capabilities to the existing transportable NASA S-band dual-polarized (NPOL) radar system.

To support future potential Aerosol-Cloud-Ecosystem (ACE) and Cloud and Precipitation Processes (CaPPM) missions we will conduct a science/engineering design study for optimizing coordinated cloud and precipitation sampling using existing Ku/Ka Band (Dual-frequency, Dual-polarized, Doppler Radar, D3R) and W-band (Aerosol, Cloud, Humidity, Interactions Exploration and Validating Enterprise, ACHIEVE) radar assets to conduct triple-frequency radar measurements across the cloud and precipitation process spectrum. Furthermore, as a means to extend these short-wavelength measurements into heavy precipitation regimes we will conduct an accompanying engineering design study to add Ku-band capability to NASA's existing NPOL (dual-polarized S-band) radar.

Anticipated Benefits

Both the ACE and CaPPM missions recognize the value of multi-frequency, dual-polarization, Doppler (W, Ka, Ku band) radar remote sensing tools as a means to profile the cloud particle and precipitation process continuum to gain a better understanding of cloud physics (e.g., transitions of aerosol to cloud and subsequent rain water) and climate impacts.

Further, the addition of a Ku frequency to NPOL allows GSFC to be the only facility capable of co-aligned, time synchronous Ku measurements with non-attenuating measurements spanning light-precipitation to heavy rain, and thus span satellite- and ground-based D3R radar measurements. Collectively these radars will provide pre-launch science algorithm development data and post-launch validation for both the ACE and CaPPM missions. Further, the intrinsic transportability of all three radars will be maintained, thus allowing for flexibility in the targeting of cloud and precipitation observations to specific climate regimes.

Historically, NASA missions such as the Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurement (GPM) missions were designed to be research programs; however, the global observations of rainfall as well as tropical and other cyclones were quickly recognized by other agencies, such as the National Atmospheric and Oceanic Administration (NOAA) as important operational tools to be utilized for forecasting and public safety. The upcoming



NASA's Dual-polarization, dual-frequency, Doppler (D3R) radar [front] and S-band NPOL radar [back]

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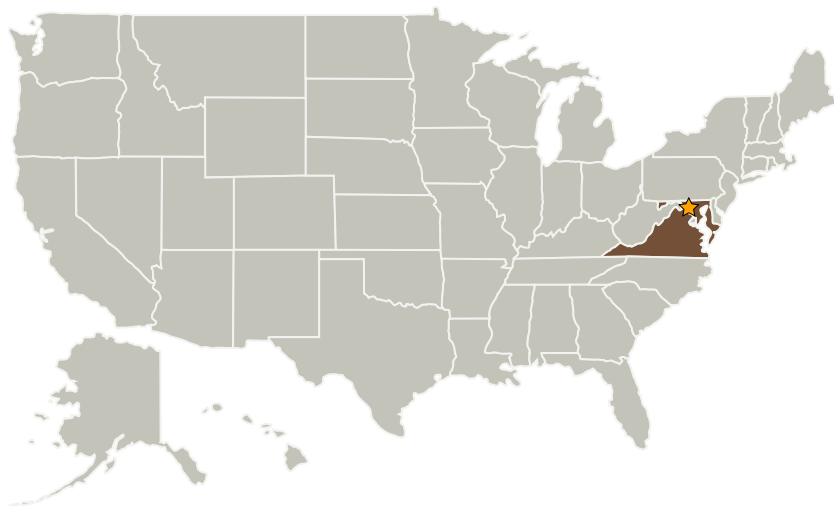
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ACE and CaPPM missions are also likely to provide valuable global measurements for aerosols and cloud processes that will be similarly used by other agencies such as NOAA. This study will serve a valuable role in validating both the ACE and CaPPM missions.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
Marshall Space Flight Center (MSFC)	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Maryland	Virginia

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Matthew J McGill

Principal Investigator:

David B Wolff

Co-Investigators:

Gregory E Martins
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Images



NASA Aerosol-Cloud-Humidity Interaction Exploring & Validating Enterprise (ACHIEVE) radar

The W-band Aerosol, Cloud, Humidity, Interactions Exploration and Validating Enterprise (ACHIEVE) is a fully deployable mobile laboratory containing active and passive sensors for measuring cloud, aerosols, and precipitation properties.

(<https://techport.nasa.gov/image/18976>)



NASA's D3R and NPOL Transportable Radars

NASA's Dual-polarization, dual-frequency, Doppler (D3R) radar [front] and S-band NPOL radar [back]

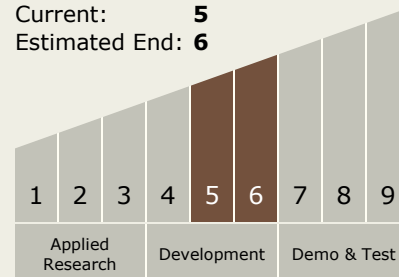
(<https://techport.nasa.gov/image/18975>)

Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

Technology Maturity (TRL)

Start: 5
Current: 5
Estimated End: 6



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves